

OPEN GEL DELIVERY DEVICE

RELATED APPLICATION

5 **(0001)** This application claims the benefit of U. S. Provisional Application
No. 60/426,588, filed November 15, 2002.

BACKGROUND OF THE INVENTION

10 **(0002)** The present invention relates to dispensers of volatile materials,
which comprise a gel-type solid or semi-solid mass of material which is designed
to release the maximum amount of volatile material over time, with a near-linear
release rate. That is, the rate of release of volatile material is essentially uniform
over the life of the dispenser.

15 **(0003)** The public is familiar with a number of solid or gel type air fresh-
eners or dispensers of volatile materials. Most familiar are those which are sold
to the public as Glade® air fresheners, produced by S. C. Johnson & Son, Inc.,
Racine, WI., and Renuzit® air fresheners, a product of Dial Corporation, of
Scottsdale, AR. While other dispensers of volatile materials, and air fresheners,
20 are known, such as liquids incorporating wicks to assist in the evaporation of the
liquid, and materials which may be heated to volatilize fragrances or other
vaporizable components, the present invention is specifically directed to dispens-
ers of volatile materials wherein a fragrance or other volatile active is encom-
passed within a solid or semi-solid material and is released over time by vapori-
25 zation, to provide a pleasing fragrance, to release a pesticide or insect control
material, to counter offensive odors, or to serve some other purpose. Aside from
the problem of evaporation of volatile material from the dispenser prior to sale to
the consumer, a problem associated with such dispensers is the drying, or
shriveling, of the gel as the active material is released, resulting in an unattractive
30 mass of hardened and emptied material to be disposed of, while the active, or
volatile material is dispensed from the gel at an uneven or variable rate. That is,

the fragrance or other active material is dispensed from the gel at a high rate upon initial exposure to the atmosphere, and more slowly as time passes, so that near the end of the life span of the dispensing device and its contained material, the volatile material is being released at rate which is much lower than the initial rate of release.

BRIEF SUMMARY OF THE INVENTION

(0004) We have found that a near-linear release of actives from a gel type dispenser of active materials may be achieved by providing the gel in a specific configuration, whereby delivery of the active to the atmosphere is enhanced.

(0005) Such systems may be classified, generally, as either a semi-enclosed gel, or an open gel system. For understanding, we have defined a semi-enclosed gel system as being one in which only part of the gel surface is exposed directly to flowing ambient air, and an open gel system as being one in which essentially the total available gel surface is exposed to the ambient air. The present invention addresses open gel systems.

(0006) The total release rate from an open gel (TRR_{OG}) is proportional to the surface area of the entire gel, as given by the following expression:

$$(1) \quad TRR_{OG} = K * C_o * A_D$$

Where, C_o = Concentration of the active at the gel surface,

K = Mass Transfer Coefficient, and

A_D = Surface Area of the gel in a the completely open device

(0007) Based on Equation 1, a close to zero-order release (i.e., constant release rate with time) can be obtained in a completely open gel system only if the surface area of the gel A_D remains constant or is permitted to change only by a small fraction during the entire life of the product. Thus, by careful control of the configuration of the gel surface we are able to achieve a zero-order release of active materials from the gel system, providing a relatively constant release rate

of the active material from initial opening until final disposal upon completion of evaporation of the active material.

BRIEF DESCRIPTION OF THE DRAWINGS

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(0008) Figure 1 illustrates the exterior container of a gel type dispenser of volatile materials in accordance with the present invention, in perspective view.

(0009) Figure 2 illustrates the planar relationship of the coordinates of a gel system in accordance with the present invention.

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DETAILED DESCRIPTION OF THE INVENTION

(0010) The present invention is related to gel type dispensers of active, or volatile materials, of the type commonly employed for air freshening, insect control, odor abatement, and the like. As shown in Figure 1, such a dispenser (1), commonly comprises a base (2), and a cover or closure member (3) in which the base contains a volatile material, for example an air freshening deodorizer or fragrance, and in which the closure or cover is manually displaceable with respect to the base to provide means for control of the effective rate of volatilization or evaporation of the active material. In the case of an open gel system, the cover, 2, is simply removed from over the gel system, thereby permitting full access of the atmosphere to all available surfaces thereof. Such cover or closure member commonly may be positively locked with respect to the base, as shown in Figure 1, to prevent unintended evaporation or volatilization of the active material. After opening of the closure member to expose the contained gel, the cover may be adjusted relative to the base to permit substantial control or variation of the rate of volatilization of the gel, in the case of a semi-enclosed gel system. Said base and cover may preferably be of a molded plastic material, although other materials may be utilized. The container may further comprise support members or posts, around which the gel member is molded or formed, which members or posts, which may be singular or plural, provide support and strength to the gel material

in the container. The gel materials to which the present invention applies are well known to practitioners of the art, as are the methods of manufacture and positioning in a container such as shown in Figure 1, and need not be discussed in greater detail for the purpose of this invention. The provision of active or volatile materials, and the choice thereof for the purposes of the dispensing devices of this invention, are also well known, and as such need not be discussed further. Rather, the present invention is directed to the relationship of the dimensions of the gel or solid actives containing material of the device.

(0011) To achieve a constant (zero-order) release rate for the volatile within a gel system, it is useful to consider that the three dimensional configuration of the actives containing material (hereinafter the gel system), as shown in Figure 2.

(0012) In figure 2, dimensions x, y, and z are illustrated, having an origin point (0,0,0) at the intersection of said dimensions, wherein the gel system should be placed in such a way that it completely lies in the first quadrant of the x,y,z coordinate system and one point touches the origin point (0,0,0). The dimensions x, y, and z are defined as:

x = the dimension measured in the x direction of the projection of the gel system in the x-z plane

y = the dimension measured in the y direction of the projection of the gel system in the x-y plane

z = the dimension measured in the z direction of the projection of the gel system in the x-z plane

(0013) The values of dimensions x, y, z are arranged in decreasing order such that :

a_i^0 is the largest value of x, y, or z at the initial condition,

c_i^0 is the smallest value of x, y, or z at the initial condition,

b_i^0 is the remaining value of x, y, or z at the initial condition,

a_F^0 is the largest value of x, y, or z at the final condition,

c_F° is the smallest value of x, y, or z at the final condition, and
 b_F° is the remaining value of x, y, or z at the final condition,
wherein initial condition and final condition refer to the dimensions of the gel
system prior to volatilization, and after volatilization, respectively.

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(0014) To maintain a release rate that does not deviate significantly from
zero Order release, the following conditions must be met:

$b_i^{\circ} > 1.2 c_i^{\circ}$, preferably $b_i^{\circ} > 5 c_i^{\circ}$, and more preferably $b_i^{\circ} > 20$
 c_i° ,

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$a_i^{\circ} > 1.6 c_i^{\circ}$, preferably $a_i^{\circ} > 8 c_i^{\circ}$, and more preferably $a_i^{\circ} > 25$
 c_i° , the value of $\alpha_1 > 2.5$, preferably > 10 , and more preferably > 30

where, $\alpha_1 = (\alpha_1)(\alpha_2)(\alpha_3)$, wherein

$\alpha_1 = a_i^{\circ} / b_i^{\circ}$, $\alpha_2 = b_i^{\circ} / c_i^{\circ}$, and $\alpha_3 = a_i^{\circ} / c_i^{\circ}$

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and, the value of $\beta_F / \alpha_1 > 3$, preferably > 10 , and more preferably > 30

where $\beta_F = (\beta_1)(\beta_2)(\beta_3)$, wherein

$\beta_1 = a_F^{\circ} / b_F^{\circ}$, $\beta_2 = b_F^{\circ} / c_F^{\circ}$, and $\beta_3 = a_F^{\circ} / c_F^{\circ}$

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(0015) In accordance with these conditions, we have found that an open
gel system having x, y, and z values of 9, 5, and 7, respectively, provide a
relatively constant rate of dispensing the volatile material, such that the release
rate of active materials is essentially the same from the initial activation of the
dispenser until it is totally used up.

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